

IN THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) A lithographic projection apparatus comprising:
a support structure configured to support a patterning device, the patterning device serving to pattern a beam of radiation according to a desired pattern;
a substrate table configured to hold a substrate;
a projection system configured to project the patterned beam onto a target portion of the substrate; and

a displacement measuring system configured to measure the position of a moveable object ~~comprising one of~~ in at least two degrees of freedom, the moveable object comprising said support structure and or said substrate table in at least two degrees of freedom, said displacement measuring system comprising at least one grid grating mounted on said moveable object and at least one sensor head configured to measure displacements of said grid grating in two degrees of freedom,

wherein the at least one grid grating includes a reference mark detectable by the respective sensor head for defining a reference position of the moveable object.

2. (Currently Amended) ~~An~~ A lithographic projection apparatus ~~according to claim 1, comprising:~~

a support structure configured to support a patterning device, the patterning device serving to pattern a beam of radiation according to a desired pattern;

a substrate table configured to hold a substrate;

a projection system configured to project the patterned beam onto a target portion of the substrate; and

a displacement measuring system configured to measure the position of a moveable object in at least two degrees of freedom, the moveable object comprising said support structure or said substrate table, said displacement measuring system comprising wherein said displacement measuring system comprises two grid gratings mounted on said moveable object at spaced apart locations and two sensor heads each configured to measure displacements of a respective one of said grid gratings in two degrees of freedom.

3. (Previously Presented) An apparatus according to claim 1, wherein said grid grating is incorporated directly into the main body of said moveable object.

4. (Previously Presented) A lithographic projection apparatus comprising:
a support structure configured to support a patterning device, the patterning device serving to pattern a beam of radiation according to a desired pattern;
a substrate table configured to hold a substrate;
a projection system configured to project the patterned beam onto a target portion of the substrate; and
a displacement measuring system configured to measure the position of a moveable object comprising one of said support structure and said substrate table in at least two degrees of freedom, said displacement measuring system comprising at least one grid grating mounted on a reference frame and at least one sensor head mounted on said moveable object configured to measure displacement of said moveable object relative to said grid grating in two degrees of freedom.

5. (Currently Amended) ~~An~~ A lithographic projection apparatus according to claim 1, comprising:
a support structure configured to support a patterning device, the patterning device serving to pattern a beam of radiation according to a desired pattern;
a substrate table configured to hold a substrate;
a projection system configured to project the patterned beam onto a target portion of the substrate; and
a displacement measuring system configured to measure the position of a moveable object in at least two degrees of freedom, the moveable object comprising said support structure or said substrate table, said displacement measuring system comprising at least one grid grating mounted on said moveable object and at least one sensor head configured to measure displacements of said grid grating in two degrees of freedom,
wherein said moveable object is moveable in a first direction for scan imaging and said grid grating has a length in said first direction greater than or equal to the range of motion of said moveable object in said first direction.

6. (Currently Amended) ~~An~~ A lithographic projection apparatus according to claim 1, comprising:

a support structure configured to support a patterning device, the patterning device serving to pattern a beam of radiation according to a desired pattern;

a substrate table configured to hold a substrate;

a projection system configured to project the patterned beam onto a target portion of the substrate; and

a displacement measuring system configured to measure the position of a moveable object in at least two degrees of freedom, the moveable object comprising said support structure or said substrate table, said displacement measuring system comprising at least one grid grating mounted on said moveable object and at least one sensor head configured to measure displacements of said grid grating in two degrees of freedom,

wherein the ~~or each said~~ grid grating is positioned so as to be substantially coplanar with the functional surface of said patterning device supported by said support structure or a substrate held by said substrate table.

7. (Currently Amended) An apparatus according to claim 1, wherein said displacement measuring [[,]] system further comprises a memory configured to store correction information representing differences between said grid grating and an ideal grid grating and a data processing unit configured to correct measurements output by said sensor head.

8. (Previously Presented) An apparatus according to claim 1, wherein said displacement measuring system further comprises one or more capacitive or optical sensors configured to measure the position of said moveable object in degrees of freedom not measured by said grid grating and sensor head.

9. (Canceled).

10. (Previously Presented) An apparatus according to claim 1, wherein said sensor head comprises an encoder head.

11. (Previously Presented) An apparatus according to claim 1, wherein said displacement measuring system further comprises an interpolator configured to interpolate the output of the or each sensor head.

12. (Previously Presented) An apparatus according to claim 1, wherein the support structure comprises a mask table for holding a mask.

13. (Canceled).

14. (Currently Amended) A device manufacturing method comprising:
projecting a patterned beam of radiation onto a target portion of a layer of radiation-sensitive material on a substrate;

measuring displacements of one of a support structure for a patterning device for patterning the beam of radiation and a substrate table for holding the substrate, in at least two degrees of freedom using at least one grid grating mounted thereon and at least one sensor head, wherein the at least one grid grating includes a reference mark detectable by the respective sensor head for defining a reference position of said moveable object; and
supplying or making available the measured displacements for further analysis or processing.

15. (Original) A device manufactured according to the method of claim 14.

16. – 19. (Canceled).

20. (Original) A method according to claim 14, wherein said measuring displacements further comprises measuring a displacement in a z-direction perpendicular to a plane substantially parallel to a surface of the target portion.

21. (Previously Presented) An apparatus according to claim 4, wherein the at least one sensor head is configured to cooperate with the at least one grid grating to measure a displacement of the moveable object in a plane substantially parallel to a functional surface of the patterning device.

22. (Previously Presented) An apparatus according to claim 21, wherein the reference frame is the projection system.

23. (Previously Presented) An apparatus according to claim 4, wherein the at least one sensor head is an optical encoder.

24. (Previously Presented) An apparatus according to claim 4, wherein the at least one grid grating is a two-dimensional grating.

25. (Previously Presented) An apparatus according to claim 4, wherein the reference frame is substantially stationary relative to the projection system.

26. (Previously Presented) An apparatus according to claim 4, wherein the displacement measuring system further comprises a second sensor head mounted on the moveable object,

wherein the displacement measured by the at least one sensor head is in a plane substantially parallel to a functional surface of the patterning device; and

wherein the second sensor head is configured to cooperate with the at least one grid grating to measure a displacement of the moveable object along a direction substantially perpendicular to the plane.

27. (Previously Presented) An apparatus according to claim 26, wherein the second sensor head is an interferometer head and the at least one sensor head is an optical encoder head.

28. (Previously Presented) An apparatus according to claim 26, wherein the at least one grid grating is a two-dimensional grating.

29. (Previously Presented) An apparatus according to claim 28, wherein the at least one sensor head is configured to measure the displacement of the moveable object along two substantially perpendicular directions.

30. (Previously Presented) An apparatus according to claim 26, wherein the at least one grid grating includes two substantially parallel reflective faces.

31. (Previously Presented) An apparatus according to claim 26, wherein the second sensor head is a capacitive sensor.

32. (Previously Presented) An apparatus according to claim 4, wherein the displacement measuring system further comprises a second sensor head, wherein the at least one grid grating is a two-dimensional grating, wherein the at least one sensor head is configured to cooperate with the at least one grid grating to measure a displacement of the moveable object along a first direction, and wherein the second sensor head is configured to cooperate with the at least one grid grating to measure a displacement of the moveable object along a second direction, the second direction substantially perpendicular to the first direction.

33. (Previously Presented) An apparatus according to claim 4, wherein the displacement measuring system includes a second grid grating that is substantially parallel to the at least one grid grating and a second sensor head mounted on the moveable object and configured to cooperate with the second grid grating to measure a displacement of the moveable object relative to the second grid grating in two degrees of freedom.